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Author: **W. Swanson**

Reviewer: **Rich Miranda**

environmental restoration project

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Environmental Restoration Project
Standard Operating Procedure

for:

Performing Background Value Comparisons for Inorganic Chemicals

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

Performing Background Value Comparisons for Inorganic Chemicals

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NOTE: Environmental Restoration (ER) Project personnel may produce paper copies of this procedure printed from the controlled-document electronic file located at http://erinternal.lanl.gov/home_links/Library_proc.shtml. However, it is their responsibility to ensure that they are trained to and utilizing the current version of this procedure. The Quality Program Project Leader may be contacted if text is unclear.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for performing background value comparisons on inorganic chemicals at the Los Alamos National Laboratory (the Laboratory) ER Project.

2.0 TRAINING

2.1 All users of this SOP are trained by self-study, and the training is documented in accordance with QP-2.2.

2.2 The **Team Leader** will monitor the proper implementation of this procedure and ensure that relevant team members have completed all applicable training assignments in accordance with QP-2.2.

3.0 DEFINITIONS

3.1 *Artificial fill* — A material that has been imported and typically consists of disturbed soils mixed with crushed Bandelier Tuff or other rock types.

3.2 *(Laboratory) background data*—Data that represent naturally occurring concentrations of inorganic chemicals in a geological medium. The Laboratory's background data are derived from samples collected at locations that are either within or adjacent to the Laboratory. These locations (1) are representative of geological media found within Laboratory boundaries and (2) have not been affected by Laboratory operations.

3.3 *Background value (BV)* — A concentration of an inorganic chemical or a radionuclide used as a simple threshold value to identify if potentially contaminated site sample results are greater than background levels. A BV is either an upper tolerance limit (UTL) calculated from the Laboratory's background data or the detection limit for the analytical method used on the Laboratory's background data. UTLs are 95% upper confidence bounds on the 95th percentile of background sample concentrations in a specific geological sample medium (or group of media). BVs are the same as, and

were formerly referred to as, background screening values. For tuff media, the BV calculations for radioactive isotopes of potassium, uranium, and thorium are based on total elemental (mass) concentrations of these elements in the Laboratory's background samples. The BVs of progeny radionuclides are estimated from the parent radionuclide, assuming secular equilibrium.

3.4 *Canyon sediment* — A sample media group that consists of young alluvium in or near stream channels within a canyon.

3.5 *Qbt 1g, Qbo, Qct* — A sample media group that is comprised of three rock units: the Tshirege Member of Bandelier Tuff cooling unit 1g, Cerro Toledo interval, and Otowi Member of Bandelier Tuff. These media are encountered during deep drilling investigations on mesa tops. They can also be encountered on canyon walls or in lower reaches of canyons. BVs are not available for the individual rock units in this sample media group.

3.6 *Qbt 1v* — A sample medium that is comprised of one rock unit (Tshirege Member of Bandelier Tuff cooling unit 1v) from Bandelier Tuff. This medium is encountered during deep drilling investigations on mesa tops. This medium can also be encountered on canyon walls or in lower reaches of canyons.

3.7 *Qbt 2, Qbt 3, Qbt 4* — A sample media group that is comprised of three rock units from upper part of the Tshirege Member of Bandelier Tuff. These upper Bandelier Tuff cooling units underlie most mesa-top PRSs. BVs are not available for the individual rock units in this sample media group.

3.8 *Soil* — A sample media group that includes soil and can include artificial-fill materials. Soil refers to a material that overlies bedrock and which has been subject to soil-forming processes. The sample media group of soil includes soils from all soil horizons.

Note: These group definitions describe sample media in simplistic terms. For more detailed definitions, see the Laboratory's background data document (Ryti et al. 1998, 59730.2).

3.9 *Surface sample* — A sample taken at a collection depth that is (or was) representative of the medium's surface during the time period of investigative interest. A typical surface sample depth interval is zero to six inches for mesa-top locations, but may be up to several feet deep in sediment-deposition areas in canyons.

4.0 BACKGROUND AND PRECAUTIONS

4.1 Compare Analytical Methods

4.1.1 Select comparable methods for site samples before performing sample collection and analysis. In the event that different analytical

methods are (or were) chosen for the site's samples, determine if the methods are comparable to those used on the Laboratory's background samples. To accurately determine comparability, consultation with a trained chemist is recommended.

Note: The comparison of site analytical results with a BV is meaningful only when the site's samples are analyzed using methods that are comparable to those used on the Laboratory's background samples. The sample preparation and analytical methods used for PRS samples must be compared with those used for the background samples as reported in the Laboratory's background data document (Ryti et al. 1998, 59730.2).

4.1.2 Be aware that there are two distinct BVs each for potassium, thorium, and uranium in one or more of the geological media from the Laboratory's background data. These different BVs were calculated from the results produced by different sample preparation and/or analysis methods. They are are identified as potassium and total potassium, thorium and total thorium, and uranium and total uranium (Ryti et al., 1998, 59730.2).

4.1.2.1 The distinction between total analyses and standard analyses may be made on the basis of sample preparation alone. For example, the Laboratory's background data document identifies two separate soil BVs: one for "Uranium" and one for "Total Uranium." Total element concentrations are extracted by complete digestion of soil material using concentrated hydrofluoric acid. Partial or "leachable" analyte concentrations are extracted by partial digestion of soil material using concentrated nitric acid (e.g., EPA Method 3050A). Leachable element concentrations provide the basis for the most typical comparisons between PRS data and background concentrations. The choice of appropriate BV should depend upon the sample preparation method that was used for the site's soil data. The different soil BVs are reported in Ryti et al. (1998, 59730.2) and are identifiable by the data fields named `SAMPLE_PREP_METHOD` and `SAMPLE_PREP_METHOD_DESC` in the Facility for Information Management, Analysis, and Display (FIMAD) table `BKGD_VALUE_INFO`.

4.1.2.2 The distinction between total analyses and standard analyses may also have been made primarily on the basis of analytical method, rather than sample preparation. For example, the Laboratory's background data document identifies separate tuff BVs for "Potassium" and "Total

Potassium." The analytical method of inductively coupled plasma emission spectroscopy (following partial digestion) was performed on samples identified as "Potassium." "Total Potassium" concentrations were determined by performing instrumental neutron activation analysis on samples prepared by grinding. The choice of appropriate BV should depend upon the sample analytical method that was used for the site's data. The separate tuff BVs are reported in Ryti et al. (1998, 59730.2) and are identifiable by the data field named TECHNIQUE_CODE in FIMAD table BKGD_VALUE_INFO.

4.2 Compare Method Detection Limits

Even when analytical methods are comparable in other respects, some standard methods are not capable of detecting analyte concentrations at levels below the Laboratory's BV for that analyte. This analyte could then be reported as not detected at a level greater than the BV only because a method's detection limits were greater than the BV. Method detection limit requirements should be considered during method selection and should be specified in laboratory contracts before sample analyses are performed. This is especially important for analytes that are rarely detected (e.g., antimony, thallium, and mercury). The reporting of a chemical as nondetected because a method's detection limits are above the BV is problematic for the following reason: all site results (concentrations of detected chemicals as well as detection limits of nondetected chemicals) are compared to the BVs.

4.3 Unweathered Tuff Background Samples

If tuff from a PRS is identified as weathered, consult a geologist or geochemist to verify that the weathered tuff sample is comparable to the unweathered tuff used in the evaluation of the Laboratory's background data. In some cases it may be more appropriate to compare the site's samples from weathered tuff with soil BVs or canyon sediment BVs, depending upon sampling location.

5.0 EQUIPMENT

A computer or calculator (optional).

6.0 PROCEDURE

Note: Deviations from SOPs are made in accordance with QP-4.2.

6.1 Prepare for BV Comparisons

6.1.1 The **ER Project worker** begins by obtaining current list of BVs. This information is available from the Laboratory's background data

document (Ryti et al. 1998, 59730.2) or from FIMAD table BKGD_VALUE_INFO.

6.1.2 Obtain current list of sample preparation and analytical methods that were used on the Laboratory's background data from which the BVs were calculated. This information is available from the Laboratory's background data document (Ryti et al. 1998, 59730.2) or from FIMAD table BKGD_VALUE_INFO.

6.1.3 From the appropriate focus area, obtain the PRS data set, including at least the following fields of information: sample concentration results, reporting units of the sample concentrations, final (RFI) sample result qualifiers, sample analytical methods, and sample preparation methods.

Note: The PRS data set may be provided to the user in the same format as it is recorded in FIMAD. It is assumed that the user has familiarity with the definitions and use of the data fields in FIMAD. Data dictionaries and code definitions are available. (For copies of the dictionaries and codes, as well as answers to specific questions, contact the ER Project's Centralized Data Management group.)

6.1.4 Determine the comparability of the methods used to prepare and analyze the PRS samples and the background samples. Document the conclusions in the format requested by the focus area.

Note: If PRS sample methods differ from the Laboratory's background sample methods and professional advice is needed, consult a chemist.

6.2 Select Appropriate BVs

For each medium sampled at the PRS, select the BVs associated with the appropriate sample media group from the Laboratory's background data, as listed in steps 6.2.1 through 6.2.5.

6.2.1 For PRS samples taken from soil media, select the Laboratory's soil BVs. In this context, "soil media" includes any soil (with or without an identified soil horizon) and/or geological fill material.

6.2.2 For PRS samples taken from tuff identified as Qbt 2, Qbt 3, and/or Qbt 4, select the BVs for the sample media group of Qbt 2, Qbt 3, and Qbt 4 from the Laboratory's background data.

6.2.3 For PRS samples taken from tuff identified as Qbt 1v, select the BVs for Qbt 1v from the Laboratory's background data.

6.2.4 For PRS samples taken from tuff identified as Qbt 1g, Qbo, and/or Qct, select the BVs for the sample media group of Qbt 1g, Qbo, and Qct from the Laboratory's background data.

6.2.5 For canyon sediment samples taken in the PRS, select the canyon sediment BVs.

6.3 Compare PRS Data to Selected BVs

Note: Not all differences between PRS sample data and background sample data are identified by a BV comparison. After the BV comparison has been completed, further statistical tests may be performed to evaluate the difference between PRS sample concentrations and background sample concentrations (LANL 1998, 59596.1).

6.3.1 If the maximum result for an analyte from the PRS is greater than the BV for that analyte, identify the analyte as a chemical of potential concern (COPC).

6.3.1.1 In this context, the “maximum result” is the larger of the following two values: (1) the largest detected concentration of the analyte, or (2) the largest sample-specific detection limit reported for nondetected chemical results for the analyte.

6.3.1.2 The frequency of occurrence for site results exceeding the BVs must be reported in the data review section of an RFI report (following current RFI report format). Both the frequency of concentrations above the BV for detected chemicals and the frequency of detection limits above the BV for nondetected chemicals are reported.

6.3.1.3 Sometimes a BV comparison identifies an analyte as a COPC when it is not statistically significantly different from background. After the BV comparison has been completed, further statistical tests may be performed to evaluate the difference between PRS sample concentrations and background sample concentrations (LANL 1998, 59596.1).

6.3.2 If the maximum result for an analyte from the PRS is *not* greater than the BV for that analyte, eliminate the analyte as a COPC.

6.3.2.1 In this context, the “maximum result” is the larger of the following two values: (1) the largest detected concentration of the analyte, or (2) the largest sample-specific detection limit reported for nondetected chemical results for the analyte.

Note: The Laboratory’s ER Project has received verbal approval from NMED’s Hazardous and Radioactive Materials Bureau to use the soil and tuff BVs from the Laboratory’s background data document. The NMED’s Surface Water Quality Bureau is reviewing the canyon sediment data. Contact the ER

Project's Project Office to check on the approval status before using BVs to evaluate sediment samples from a PRS.

6.3.3 Document the results of the BV comparisons in the format requested by the focus area.

7.0 REFERENCES

The following documents have been cited within this procedure.

QP-2.2, Personnel Orientation and Training

QP-4.2, Standard Operating Procedure Development

Ryti, R. T., P. A. Longmire, D. E. Broxton, S. L. Reneau, and E. V. McDonald, September 1998. "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory," Los Alamos National Laboratory report LA-UR-98-4847, Los Alamos, New Mexico. (Ryti et al. 1998, 59730.2)

LANL (Los Alamos National Laboratory), September 1998. "Statistical Methods for Background Comparisons," draft, Los Alamos National Laboratory study, Los Alamos, New Mexico. (LANL 1998, 59596.1)

8.0 RECORDS

The results of the BV comparisons are documented in the format requested by the focus area, usually in the form of an ER Project report.

9.0 ATTACHMENTS

There are no attachments to this procedure.

Using a token card, click here to record "self-study" training to this procedure.

If you do not possess a token card or encounter problems, contact the RRES-ECR training specialist.